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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/531,047	04/12/2005	Shouichirou Sawa	MAM-061	2630

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EXAMINER	
HAN, KWANG S	
ART UNIT	**PAPER NUMBER**
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/531,047	SAWA ET AL.	
	Examiner	Art Unit	
	Kwang Han	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 March 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

LITHIUM SECONDARY BATTERY INCLUDING A NEGATIVE ELECTRODE WHICH IS A SINTERED LAYER OF SILICON PARTICLES AND/OR SILICON ALLOY PARTICLES AND A NONAQUEOUS ELECTROLYTE CONTAINING CARBON DIOXIDE DISSOLVED THEREIN AND METHOD FOR PRODUCING THE SAME

Examiner: K. Han SN: 10/531,047 Art Unit: 1795 June 29, 2010

Detailed Action

1. The Applicant's request for reconsideration filed on March 23, 2010 was received.

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Specification

3. The objection to the specification has been withdrawn in view of the Applicant's amendment to the title.

Claim Rejections - 35 USC § 103

4. Claims 1-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukui et al. (WO/2002/21616, using US 2004/0043294 for translation and citations) in view of Hiroshi et al. (JP 10-040958, machine translation) is maintained.

Regarding claim 1, Fukui et al. is directed towards a rechargeable lithium battery (abstract) comprised of the following:

- negative electrode made by sintering a layer of a mixture of active material particles containing silicon or silicon alloy [abstract],

- a binder on a surface of a conductive metal foil current collector [34],
- a positive electrode [16], and
- a nonaqueous electrolyte [16].

The active material particles of Fukui inherently undergo a porosity increase that advances from particles surfaces during charge and discharge since the active materials are the same as the Applicant's disclosed materials of an active material containing silicon and silicon alloy used in a rechargeable lithium battery [Paragraph 0003 of Applicant's disclosure] and described by Fukui [0018]. Fukui discloses the use of electrolyte solvents such as carbonate's [41] and the active material comprised of materials that alloy with lithium but is silent towards the nonaqueous electrolyte containing carbon dioxide which is dissolved therein.

Hiroshi teaches a non-aqueous electrolyte secondary battery comprised of a negative active material compound including silicon [0017] with carbon dioxide dissolved and added in the electrolyte [Abstract, 0010] for the benefit of forming a battery having superior charge and discharge characteristics and less deterioration of discharge capacity due to charge and discharge repetition. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply dissolved carbon dioxide gas within the electrolyte solution for a rechargeable lithium battery because Hiroshi teaches it provides for superior charge and discharge characteristics.

Regarding claim 2, Fukui teaches the sintering being performed under a non-oxidizing environment [9].

Regarding claim 3, the teachings of Fukui and Hiroshi as discussed above for claim 1 are herein incorporated. Fukui further discloses active material particles that undergo a porosity (volume) increase that advances inside from particle surfaces during charge and discharge [0018].

Regarding claims 4-6, Hiroshi teaches an amount of carbon dioxide dissolved in a nonaqueous electrolyte to sufficient to provide charge-discharge cycle characteristics [0012] teaching it as a result effective variable. It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the carbon dioxide content since it has been held that discovering the optimum ranges for a result effective variable such as carbon dioxide content involves only routine skill in the art in the absence of showing of criticality in the claimed range (MPEP 2144.05).

Regarding claim 7, Fukui discloses a battery construction where the electrolyte and the electrodes are enclosed in a structure [0062-0064] (Figures 1 and 2).

Regarding claim 8, Fukui teaches an electrolyte which contains a cyclic carbonate [41].

Regarding claim 9, Fukui teaches an electrolyte which contains a mixed solvent of a cyclic carbonate and a chain carbonate [41].

Regarding claim 10-12, Fukui teaches a cyclic carbonate which includes ethylene carbonate and propylene carbonate [41].

Regarding claim 13, Fukui teaches a chain carbonate which includes at least one of dimethyl carbonate, diethyl carbonate, and methyl ethyl carbonate [41].

Regarding claims 14 and 15, Fukui teaches a nonaqueous electrolyte that further contains a fluorine containing compound which is a lithium salt [41].

Regarding claim 16 and 17, Fukui teaches a fluorine containing lithium salt of the type $LiXF_y$ or $LiN(C_mF_{2m+1}SO_2)$ $(C_nF_{2n+1}SO_2)$ [41] (Examples: $LiPF_6$ and $LiN(CF_3SO_2)(C_4F_9SO_2)$).

Regarding claim 18, Fukui teaches an active material particle with the most preferable mean particle diameters of 10μm or below [27].

Regarding claim 19, Fukui teaches a current collector which has an arithmetic mean surface roughness Ra, of at least 0.2μm [18].

Regarding claims 20 and 21, Fukui teaches a current collector which comprises an electrolytic copper foil, an electrolytic copper alloy foil, or a metal foil having an electrolytic copper or copper alloy surface layer [22].

Regarding claim 22 and 23, Fukui teaches a binder which remains even after a heat treatment for sintering and comprised of polyimide [35].

Regarding claim 24, Fukui teaches active material particles composed of silicon [26].

Regarding claim 25, Fukui teaches an electric conductor which is mixed in the mixture layer [57].

Regarding claim 26, Fukui teaches a method for fabricating a rechargeable lithium battery comprising the step of:

- providing a layer of a mixture of active material particles containing silicon and/or a silicon alloy [9],

- a binder on a surface of a conductive metal foil as a current collector [9],
- sintering the mixture layer while being place on the surface of the conductive metal foil to prepare the negative electrode [9], and
- assembling the battery using the negative electrode, positive electrode, and nonaqueous electrolyte [16].

The active material particles of Fukui inherently undergo a porosity increase that advances from particles surfaces during charge and discharge since the active materials are the same as the Applicant's disclosed materials of an active material containing silicon and silicon alloy used in a rechargeable lithium battery [Paragraph 0003 of Applicant's disclosure] and described by Fukui [0018]. Fukui discloses the use of electrolyte solvents such as carbonate's [41] and the active material comprised of materials that alloy with lithium but is silent towards the nonaqueous electrolyte containing carbon dioxide which is dissolved therein.

Hiroshi teaches a non-aqueous electrolyte secondary battery comprised of a negative active material compound including silicon [0017] with carbon dioxide dissolved and added in the electrolyte [Abstract, 0010] for the benefit of forming a battery having superior charge and discharge characteristics and less deterioration of discharge capacity due to charge and discharge repetition. It would have been obvious to one of ordinary skill in the art at the time of the invention to apply dissolved carbon dioxide gas within the electrolyte solution for a rechargeable lithium battery because Hiroshi teaches it provides for superior charge and discharge characteristics.

Regarding claim 27, Fukui teaches the sintering being performed under a non-oxidizing environment [9].

Regarding claim 28, Hiroshi teaches a step of dissolving carbon dioxide in the nonaqueous electrolyte including pressurizing with gaseous carbon dioxide into the nonaqueous electrolyte [0010].

Regarding claim 29, Fukui is silent to the use of a carbon dioxide atmosphere during the assembly of the rechargeable lithium battery. Hiroshi teaches a method of forming the electrochemical cell under a carbon dioxide content environment for the benefit of enclosing carbon dioxide within the cell [0012]. It would have been obvious to one of ordinary skill in the art at the time of the invention to assemble the electrochemical cell under a carbon dioxide environment because Hiroshi teaches it allows for enclosing carbon dioxide within the cell.

Response to Arguments

5. Applicant's arguments filed March 23, 2010 have been fully considered but they are not persuasive.

Applicant's principal arguments are:

(a) the Hiroshi reference teaches that the effect of carbon dioxide contained in the nonaqueous electrolyte requires a specific material in the negative electrode, and

(b) the Fukui and Hiroshi reference fail to discloses an increase in porosity of the negative electrode active material particles during charge and discharge to be suppressed by the addition of the dissolved carbon dioxide.

In response to Applicant's arguments, please consider the following comments:

(a) the Fukui and Hiroshi references are both directed toward lithium secondary cells using transition metal oxides including $LiCoO_2$ (paragraph 0033 of Hiroshi, paragraph 0042 of Fukui), an electrolyte comprising ethylene carbonate and $LiPF_6$ or $LiBF_4$ (paragraph 0051 of Hiroshi, paragraph 0041 of Fukui) and with anodes comprised of silicon alloys. While Hiroshi does disclose the use of a specific negative pole active material, one of ordinary skill in the art would still look towards the teachings of Hiroshi to further modify the secondary battery of Fukui to provide further performance enhancements since the electrolyte composition and the positive electrodes are identical. Furthermore, Hiroshi further recognizes that carbon dioxide in a cell is conventionally known to be used to prevent the formation of a coating on the cathode [0008], and

(b) In response to Applicant's argument that the cited references fail to show a suppression of the increase in porosity of the negative electrode, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kwang Han whose telephone number is (571) 270-5264. The examiner can normally be reached on Monday through Friday 8:00am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dah-Wei Yuan can be reached on (571) 272-1295. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/K. H./
Examiner, Art Unit 1795

/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 1795